

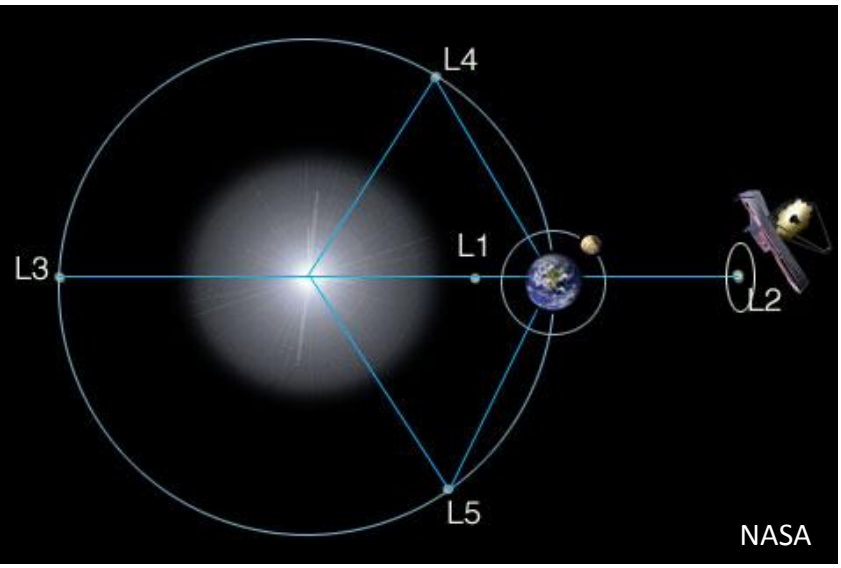
February 2022

JWST success!

A lot has happened since the last Topical Science Update at the start of December 2021. The Ariene 5 rocket carrying the James Webb Space Telescope (JWST) launched successfully on Christmas Day.

Since then scientists round the world have watched on nervously as the ambitious telescope travelled 1.5 million miles to it's orbit and unfolded in several hundred nerve-wracking steps with multiple mission failure points.


ESA/NASA/CSA – Artists impression



All that hard work and stress has so far been worth it – JWST has reached it's orbit point at L2 and has fully deployed successfully.

The next steps involve continuing to cool down the instruments on board and testing that everything is working as it should be. The first images from JWST should be released in about 5 months – stand by to be inspired!

[JWST Launch](#) [How JWST will work](#) [Where is Webb](#) [Webb at L2](#)

Bionic Eyes

An 88-year-old woman has become the first patient in the UK to have a groundbreaking bionic eye implant that enables her to detect signals for the first time since going blind.

The breakthrough involves a revolutionary chip implanted behind the blind eye. Hi-tech camera glasses capture the scene in front before relaying the data to the implant that sends an electrical signal to the brain – just like natural vision.


Pixabay

[Bionic Eye Implant](#)

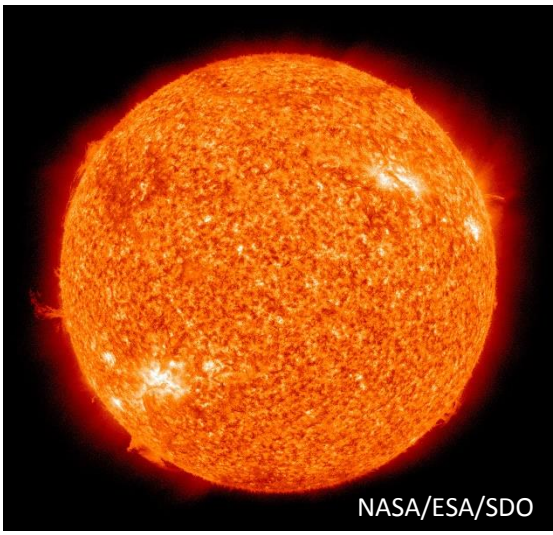
[Bionic Eye Technology](#)

[How your eyes work](#)

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The Spotty Sun (and how we study it)

By Dr Helen Mason OBE, University of Cambridge


NASA/ESA/SDO

You may well think that the Sun is rather boring, always there and always constant. We do rather take it for granted, even if sometimes it is hidden by clouds. The Sun gives us everything we need for life here on Earth - light, heat, energy. The Sun is our star. However, I can assure you that it is far from boring or constant, it is fascinating.

I have studied the Sun for decades, mainly from space observatories, working with NASA, ESA (European Space Agency), Japanese and Indian colleagues.

I have worked on many solar space missions, including **SoHO** (Solar and Heliospheric Observatory), **Hinode** and **SDO** (Solar Dynamics Observatory).

Find out more.

SoHO Hinode SDO


David Mark, Pixabay

Most recently, two solar satellites have been sent very close to the Sun to study the interaction of the Sun with the Earth, probing the solar wind which flows off the Sun.

This can cause the beautiful Northern Lights (aurora borealis) and southern lights (aurora australis), but it can also be damaging - affecting technology, harming astronauts, damaging satellites and causing electricity black-outs.


NASA/Parker Solar Probe

Parker Solar Probe



ESA/NASA/Solar Orbiter

Launch of the Solar Orbiter

NASA's Parker Solar Probe was launched in 2018 and ESA/NASA's Solar Orbiter was launched in 2020. Both are orbiting around the Sun, using the gravitational pull of Venus to bring them closer and closer.

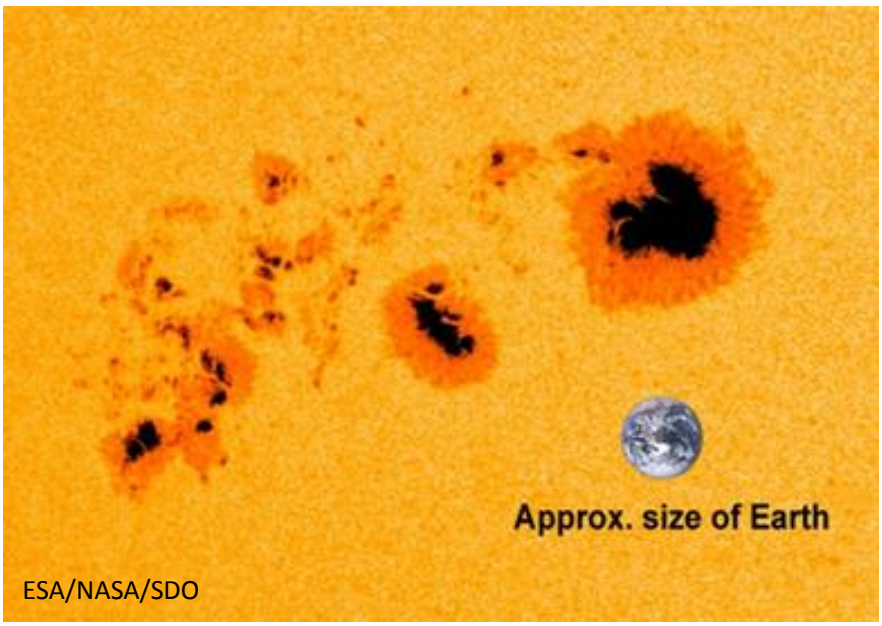
Find out more. Parker Solar Probe Solar Orbiter

This is where I remind you **never to look directly at the Sun**, it is far too bright and can seriously damage your eyes. We either project an image of the Sun onto something, or use special solar telescopes on Earth. Scientists also study observations from space in all wavelengths, from visible to UV and X-rays.

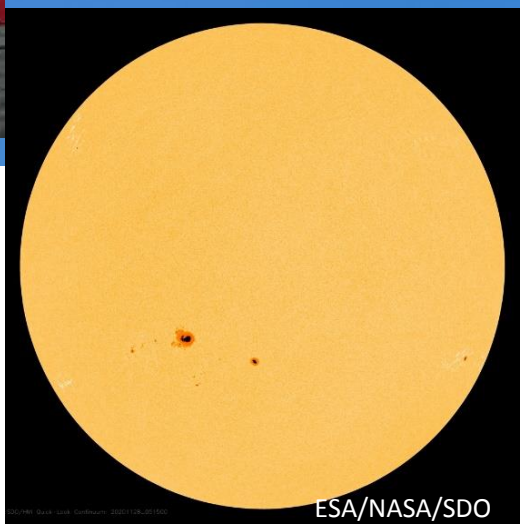


Helen Mason taught students in South Africa how to study the Sun safely with a sunspotter

These look small, but because the Sun is so huge, they can be the size of the Earth! These sunspots were first seen by the ancient Chinese through the early morning mist.



Projecting an image of the Sun, as is being done here with a sunspotter, we sometimes see dark spots on the Sun's surface called sunspots.



Sunspots on the Sun's surface

Find out more.

What are Sunspots?

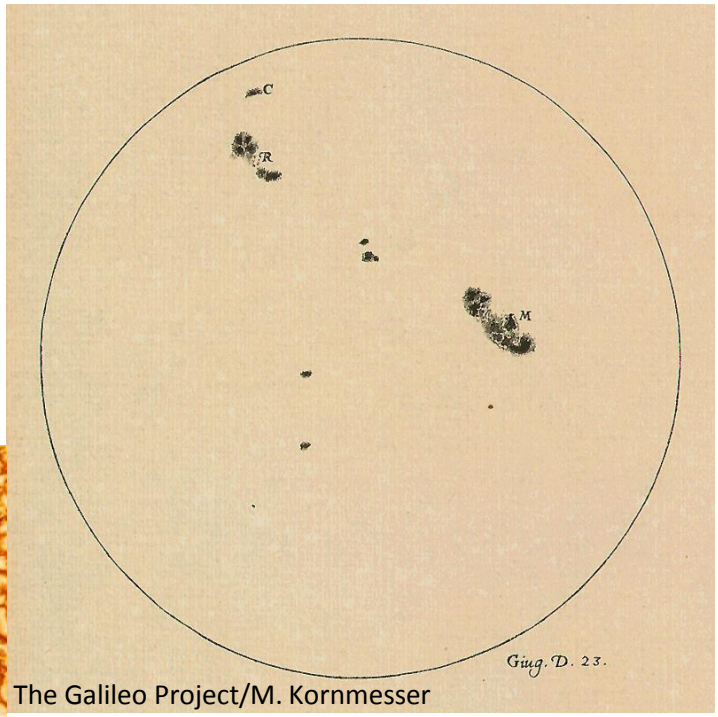
Sunspots and solar flares

A Closer look at the Sun

Galileo was amongst the first astronomers to study these sunspots regularly, and to realise that they were associated with the Sun. He also discovered that the Sun spins on its axis taking around 25 days to revolve once at the it's equator.

Galileo made detailed drawings and recordings along with others, for example from the Royal Observatory of Greenwich, were crucial in our realisation that over a long period of time, the number of sunspots changes.

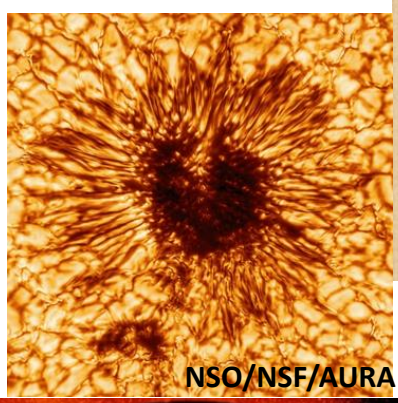
Sometimes there are none at all, sometimes the Sun is very spotty. This cycle of sunspots is around 11 years.

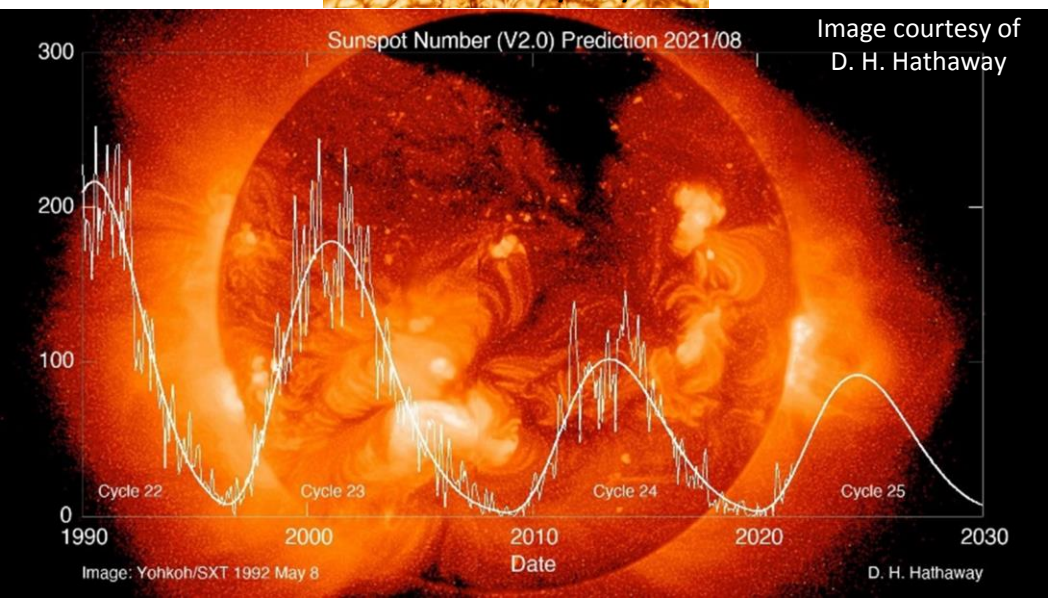


The Galileo Project/M. Kornmesser

Galileo sketched his sunspot observations

Close up detail of a sunspot from DKIST


NSO/NSF/AURA

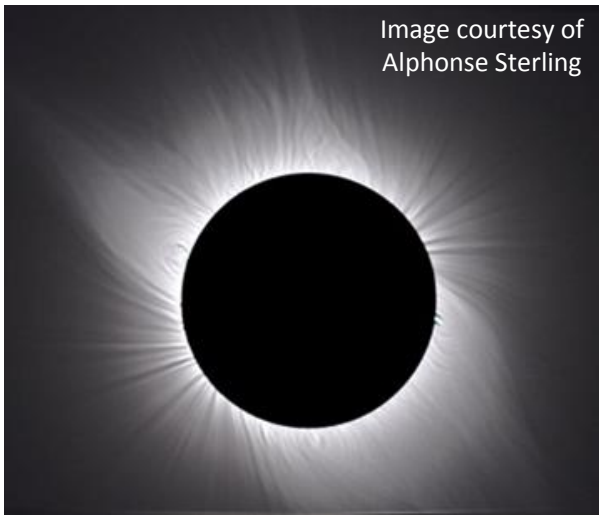


Graph of the sunspot cycle from 1990 to 2021 showing peaks every 11 years.

The core of the Sun where energy is released by nuclear fusion, Hydrogen atoms fusing together to form Helium, is around 15 million °C.

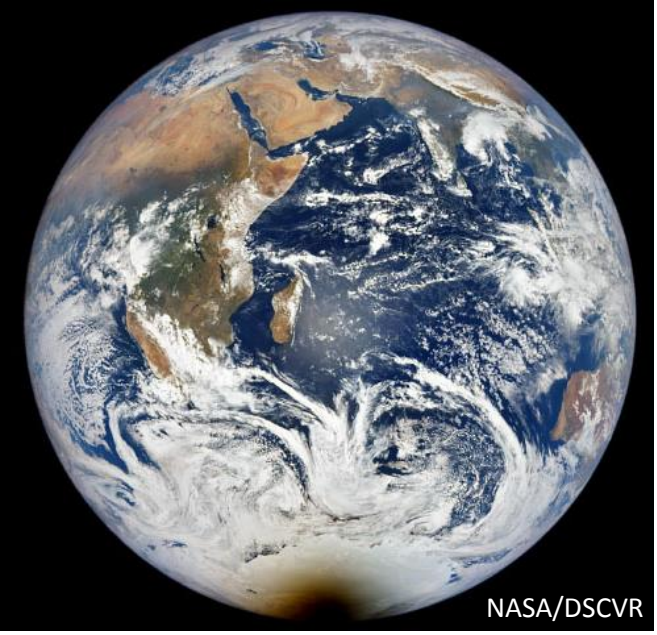
This energy gradually moves out towards the surface, called the photosphere, which is around 5,500 °C.

During a total eclipse of the Sun, when the Moon exactly blocks the bright disk of the Sun, we see a crown of light which is the Sun's corona, the solar atmosphere.



A total eclipse of the Sun reveals the corona.

Experience a total solar eclipse How an eclipse works



The most recent total eclipse of the Sun was in Antarctica in December 2021.

Photographed by NASA's EPIC camera aboard the Deep Space Climate Observatory (DSCVR).

Antarctica Solar Eclipse

DSCOVR & EPIC

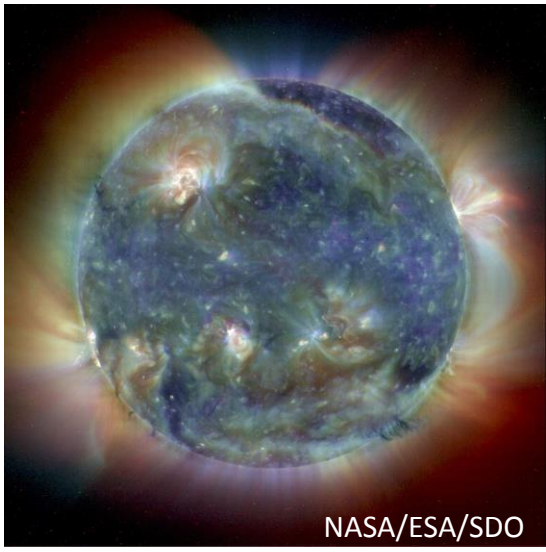
Amazingly, the Sun's corona is around 1 million °C. This was discovered, after years of investigation, by scientists studying the visible spectrum of the Sun during eclipses.

Why is the corona so hot?

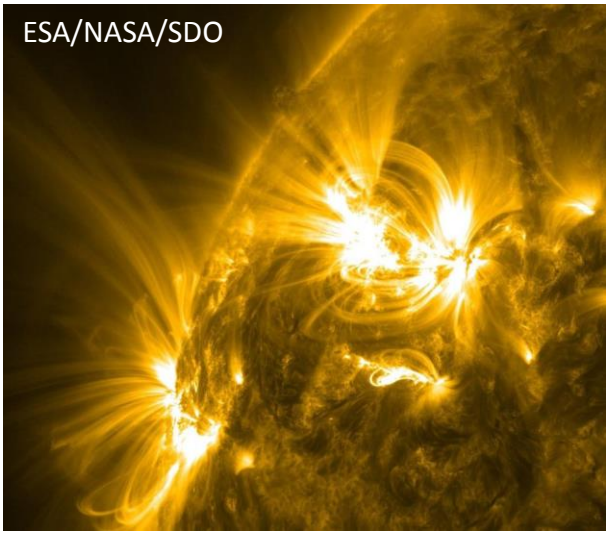
This is one of the main puzzles which solar scientists have been trying to solve. Although quite a lot of progress has been made and we know that the Sun's magnetic field plays a key role, the mystery is not yet fully solved. Because the corona is so hot, it shines brightly in UV and X-ray radiation.

The Sun's Corona

What is UV light?



UV image of the sun taken by ESA's Solar Dynamics Observatory.



Solar activity is monitored by the SDO

Sunspots are regions on the Sun where the magnetic field is strongly concentrated and this has inhibited the heat from inside the Sun reaching the surface.

Although the surface of the Sun (photosphere) is around 5,500C, the sunspots are a bit cooler, around 3,900C, and hence appear darker, although in fact they are brighter than a full Moon!

These sunspots regions form the foot-points of huge and beautiful hot coronal loops seen in the UV and X-rays.

Coronal Loop Solar Flare vs CME

This sunspot cycle is accompanied by a cycle of solar activity. When there are few sunspots, the Sun is sleepy, quiet, and to be honest just a little bit boring!

However, when there are many sunspots, the Sun wakes up, we begin to see a lot of activity, explosions, solar flares and eruptions - coronal mass ejections.





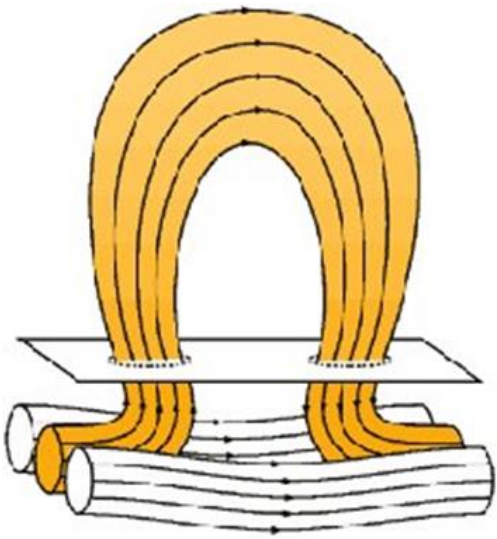
High solar activity causes aurora on Earth.

At the moment, the Sun is just waking up, it has been through a period of solar minimum but now the activity levels and number of sunspots are rising. The Sun recently produced an X-class flare and solar researchers are getting very excited and coming out of hibernation!

We anticipate a maximum of solar activity in about 4-5 years' time, so watch out for some very big solar flares and beautiful displays of the Northern Lights.

So, what causes this cycle of solar activity?

The magnetic field on the Sun is formed beneath the surface, as hot charged gas rotates. The rotation of the Sun is not uniform and the magnetic fields get twisted up, eventually erupting through the surface forming sunspots and huge coronal loops.



Coronal loops are formed when the Sun's magnetic field bursts through the surface.

The plasma, hot, ionised gas, in the solar atmosphere flows out into the solar wind. Solar flares and explosions shoot material into space, sometimes reaching the Earth's environment. Fortunately, the Earth is protected to some extent by its own magnetic field. However sometimes this blanket of protection is disturbed leading to geomagnetic storms, aurorae and other more damaging effects.

Forecasting Space Weather

How to forecast space weather

This process is called 'space weather' and is high on the UK's risk register for economic damage. Hence, the Met Office now has a branch dedicated to forecasting Space Weather. This important area of research involves many scientists and engineers with the aim of understanding how the Sun affects us here on Earth. I like to think of myself, and my own solar research, as one small piece in a giant jigsaw.

'Is our Sun unique?'

Of course it is unique to us here on Earth, but it is actually pretty ordinary compared to all the other stars we can see in the sky. It is a stellar main sequence star like 100s of billions of other stars in the Milky Way galaxy.

All the stars we can see in the night sky are from our home galaxy.

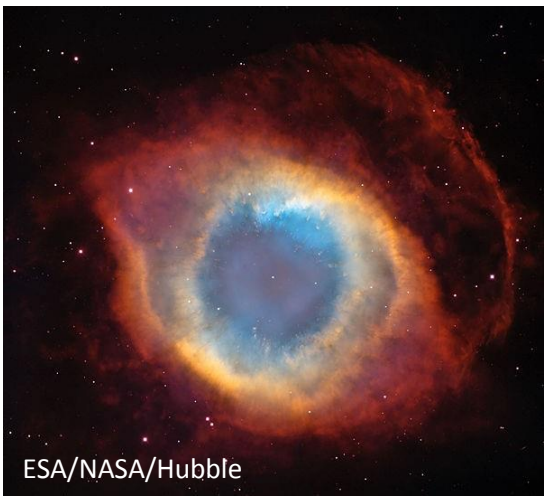


The Milky Way galaxy is at least 100,000 light years across and has between 100 and 400 billion stars.



The Orion Nebula is a stellar nebula where new stars are been born.

We can see some stars being born and others reaching the end of their lifetime. The Sun is middle aged, about halfway through its life - 4.5 billion years old. In about 5-6 billion years it will expand, as a red giant, and explode into a planetary nebula. It will leave behind a core white dwarf.



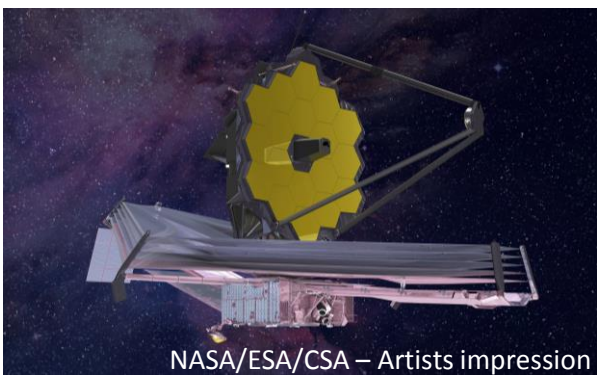
The Helix Nebula is a planetary nebula where a star has died and a solar system been destroyed.

Had the Sun been ten times more massive, its end would have been even more spectacular, as a supernova, leaving behind a black hole in its centre.

Size of the stars
Scale of the Universe

Do other stars have 'star-spots', cycles of activity, stellar flares?

Indeed, they do. As we look for exo-planets, planets orbiting around other stars on which life could survive, we must also consider how active the host stars are. If they are too violent, life cannot endure.



The James Webb Space Telescope is going to change our understanding of the Universe..

The James Web Space Telescope successfully launched on Christmas Day, 2021, will be used to search for the birth of new stars and also for exo-planets. The results are likely to be spectacular.

JWST Webb

Teachers Guide

Dr Helen Mason OBE

University of Cambridge SunSpaceArt



I have a passion for studying the Sun which I love to share with others. Over the past 5 years I have led a project called ***SunSpaceArt***, which is funded by the Science and Technology Facilities Council (STFC).



An important component of our workshops are Q/A sessions. The output and feedback from our workshops have been wonderful: 'Today I loved this lesson because the science and art inspired me'.

We have reached out to those schools and children from diverse backgrounds, and most in need of science enrichment.



Members of the SunSpaceArt team are also involved with several other creative school activities, involving space exploration, atoms, environmental science linked with the visual arts, dance and music (see useful links).

The SunSpaceArt team were honoured to receive the Sir Arthur Clarke Team Award for Space Achievement in Education and Outreach in summer 2021.

If you would like to find out more about our work, or tell us about your science/art activities, please do contact us (info@sunspaceart.org).

The SunSpaceArt team includes scientists, space educators and professional artists. We have worked together with over 150 schools (KS2 and KS3), 7000 children and 1000 teachers though out the UK. The aim is to inspire children, to use artistic methods to re-enforce their science learning and to develop confidence and creative skills.



Blogs about our SSA workshops, together with downloadable activity sheets, can be found at on our **website** and short videos can be found on our **YouTube channel**.

We encourage teachers to take a look at our resources and try out some of these creative STEAM (STEM + Arts) activities. They range from simple 'postcards from the Moon', 'solar system collages','3D Solar satellite cards' to 'Building a village on Mars'. Our 'Making it into Space' worksheets and videos have been created by the artist and space educator Helen Schell. We have worked with many partners across the UK: Great Science Share, Comino Foundation, Techniquest (Wales), STEM NE, Ideas Foundation, Science Museum etc.

SunSpaceArt

Suntrek

STFC Resources

GSS Activities

AstroCymru

STEMfest in Space

The Human Spaceship off balance

Sustainability First

Finding Patterns